Intraocular Foreign Bodies in Naval Personnel

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PENETRATING wounds of the eyeball with lodgement of one or more foreign bodies within its deep structures were one of the more important types of injuries seen in navy personnel during the recent war.

Most of such injuries in patients admitted to one of the naval hospitals on the Pacific Coast were incurred in either (1) action against the enemy or (2) at work or in military training, usually in the vicinity of the hospital. Patients wounded in combat usually did not reach the hospital at which the author was stationed until several weeks following the injury and some of them already had received expert care at one or more hospitals along the route. Those injured in the proximity of the hospital, however, usually were seen within a few hours following the accident.

From January 1941 to July 1946 some 95 patients presumably with intraocular foreign bodies were admitted to the hospital. The records of 68 of these were analyzed.

Of the 68 patients with intraocular foreign bodies 40 received injuries in combat and 28 in the course of work or military training. In 35 of the 40 men injured in action the foreign particles in the eyes were presumed to be nonmagnetic. The particles in the remaining five were magnetic. Ten of the 40 men who were injured in action had multiple particles within the same eye and three suffered injury to both eyes. In three of the five cases in which the particles were magnetic they were successfully removed. In two cases the eyes had to be enucleated. A large number of the nonmagnetic particles were small, and as they were apparently well tolerated they were left undisturbed.

Of the 28 men who received injuries at work or in the course of training, 21 harbored magnetic particles, and in 17 of the cases these were successfully removed. In five of the seven cases in which the particles were nonmagnetic, the particles were removed. In three of the 28 cases the affected eye had to be enucleated.

DIAGNOSIS

History. In making a diagnosis of intraocular foreign body a careful history of the injury is of considerable importance. An eye that was injured while the man was exposed to flying particles of hand grenades, land mines, bombs, machine gunfire, or other flying missiles, or while the patient was hammering, drilling, etc., should be suspected of harboring a foreign particle. A careful description of the tools used and the manner in which the accident occurred help to determine the probable nature of the foreign body.

Clinical Examination. Often the wound of entrance, which may or may not be associated with prolapse of the uveal tissue or vitreous, can be seen by ordinary examination. On the other hand, the wound may be so small as to be invisible even with the aid of the slit lamp and corneal microscope. A reduction in intraocular pressure, a shallow anterior chamber, or hemorrhage in the vitreous and lenticular opacities are signs which point to an ocular perforation and the possibility of an intraocular foreign body.

In old injuries the chemical effect of the foreign body may be visible. Fragments of copper produce specific changes known as ocular chalcosis. These are seen as a peculiar greenish color in Decemet's membrane and lens capsule, and the changes in the latter produce a picture simulating a sunflower. Steel or iron retained in the eye over a long period slowly oxidizes and the products of oxidation stain the ocular tissues a reddish-brown known as siderosis. This is usually seen clinically in the lens, iris and cornea.

The following case is an example:

CASE REPORT

A carpenter's mate, aged 21, entered the hospital February 22, 1944, complaining of impaired vision in the right eye. He stated that in 1940 while he was pounding on a nail a piece of steel hit his right eye. He received medical treatment for nine days, and the eye then was apparently well. No x-ray examination was made at the time. On admission to the hospital vision in the right eye was limited to counting of fingers at six inches. The iris appeared greenish-brown in color and there were several dark brown granules dispersed through the subcapsular region of the opaque lens, giving it a dirty-grey appearance and indicating siderosis (Figure 1). Intraocular tension was normal. Roentgen examination revealed a small (1 mm.) metallic particle in the region of the ciliary body. The particle was removed by the anterior route through a small corneal incision. The lens was subsequently needled and final corrected vision was 20/20.

X-ray Examination. An x-ray examination is indicated whenever there is suspicion that a foreign body has struck the eye even though a careful clinical examination reveal no sign of injury. Small foreign bodies may not show in an x-ray film taken in one view only. In such instances several different exposures should be made, as advocated by Thorpe.[5] When a particle is not entirely radiopaque or is so small as not to show against the shadows of the bones, it can sometimes be demonstrated by the bone-free method of Vogt[2] provided it is located in the anterior segment of the eye. This is accomplished by using small

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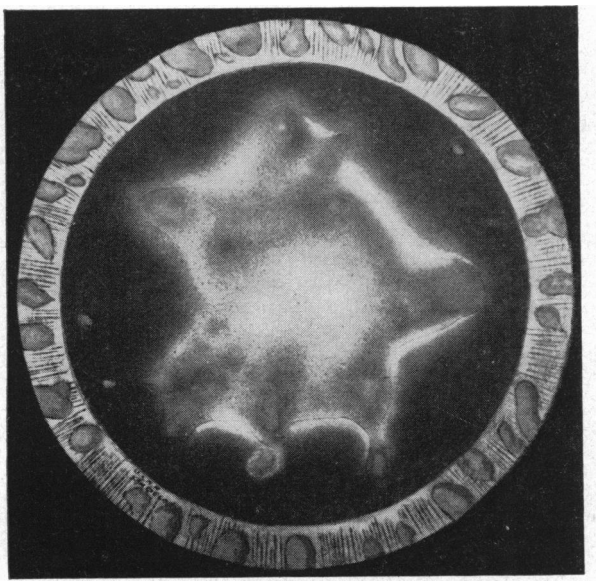

Figure 1.—Iris and lens showing siderosis.

dental films pushed deeply into the orbit at the nasal angle, with the orbit then photographed from an anterolateral position. To obtain a better exposure the eye may be made to protrude by retrobulbar injection of 3 cc. of a 1 per cent solution of procain hydrochloride.

Localization. Before extraction of a foreign body from the eyeball is attempted, its exact position in relation to the globe should be determined. This is imperative if the particle is nonmagnetic, less important if it is magnetic and its size and shape known.

There are several satisfactory methods of localization. We have employed Comberg's method.[3] A contact lens with four lead marks is placed over the cornea and two exposures are made, one exactly in the visual line (Figure 2) and one at right angle from the first exposure (Figure 3). Location of the foreign body with reference to the central point then is easily determined by drawing lines between the shadows of the marks on the plate. The meridian of the globe is found by extending the line from the foreign body to the central point to meet the horizontal drawn on the chart and the distance of the particle from the plane of the limbus is easily determined in

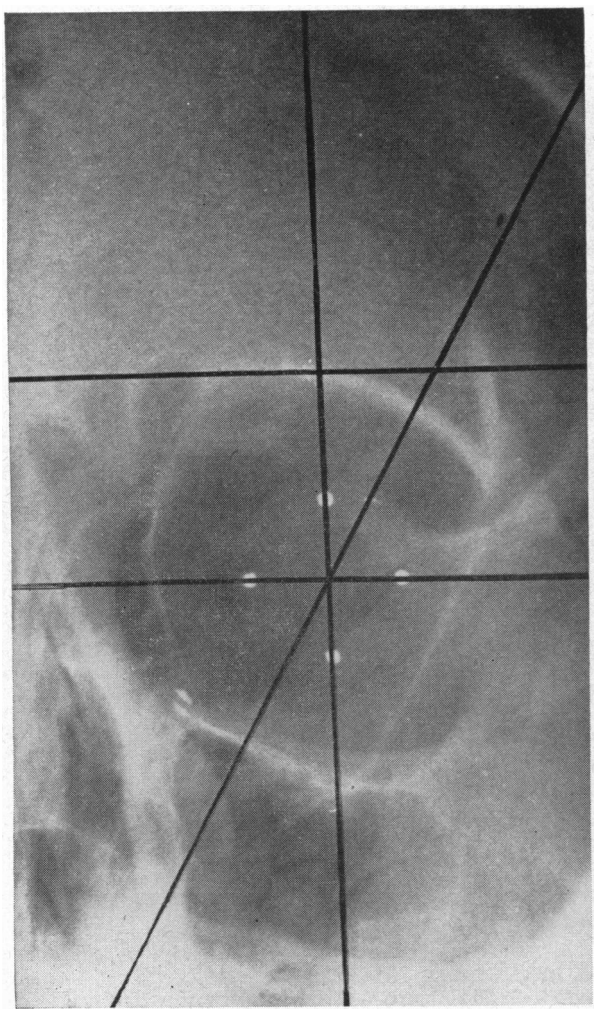

Figure 2.—Roentgenogram with lines for localization of foreign body in frontal plane according to Comberg.

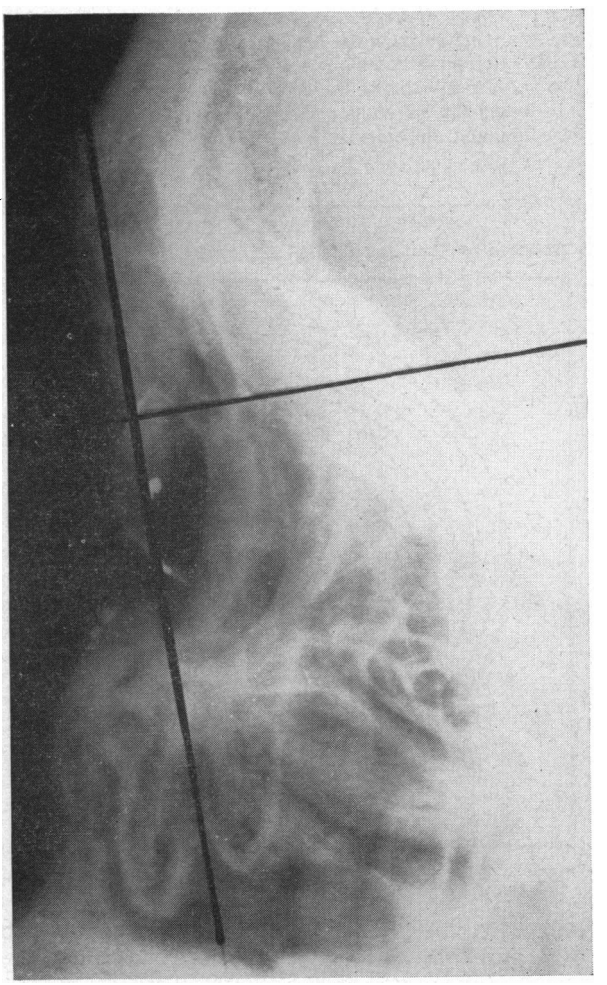

Figure 3.—Lateral view.

the lateral view. The results are then plotted on special charts (Figure 4).

Comberg's method is highly satisfactory in most cases, but occasionally error creeps into the picture and the foreign body is localized 1 or even 2 mm. from its true position. This, of course, is a serious mistake when dealing with nonmagnetic particles or when a particle is close to the periphery of the globe so that it appears to be extraocular when it is actually in the eye, or vice versa. The latter difficulty can often be eliminated by injecting air into Tenon's space to create a contrast between the globe and the surrounding tissue. The chief objection to the Comberg lens is that it sometimes slips off the cornea, thereby introducing a serious error in localization. Thorpe[6] has recently modified the Comberg lens to obviate this objection by drilling suture holes in the periphery of the lens so that it can be anchored.

If more than one foreign particle is present, and especially if one is imposed upon another, localization of each in reference to the globe may be difficult or even impossible. The following case report is illustrative:

CASE REPORT

The patient received injuries about the face and both eyes due to a hand grenade explosion. A small particle of shrapnel was removed from the left eye at another hospital. Eight weeks later, on admission to the hospital at which the author was stationed, vision in the right eye was 20/200 and in the left eye 20/20. Except for a small corneal scar, an anterior synechia, and an irregular pupil, the left eye appeared normal. The right eye presented a grey, organized mass in the lower part of the fundus and a hazy vitreous. Roentgen examination disclosed several metallic particles in the region of the eye, two of which, although appearing to be within the globe, were difficult to localize because of multiplicity of shadows in the two views.

A foreign body in the vitreous which shifts with the position of the head presents another problem in localization. Two such cases were seen among the 68 patients. In one of these the particle was magnetic and the lens was already opaque. It was easily extracted by the anterior route. In the second the particle, which was visualized through the pupil, moved freely in the vitreous with each movement of the eye. It was nonmagnetic and it was removed with a forceps under direct visualization.

TREATMENT

It may be stated categorically that any intraocular foreign body should be removed as soon as possible unless its removal involves more danger than its retention in the eye. Details of the surgical procedure and medical treatment will depend on several factors, such as the age and extent of the injury, the size, shape, nature and location of the particle.

If the injury is recent, the patient is given prophylactic doses of sulfadiazine or penicillin and injections of typhoid antigen intravenously. Antitetanic serum is often indicated. Atropine is used in most cases unless contraindicated by primary glaucoma.

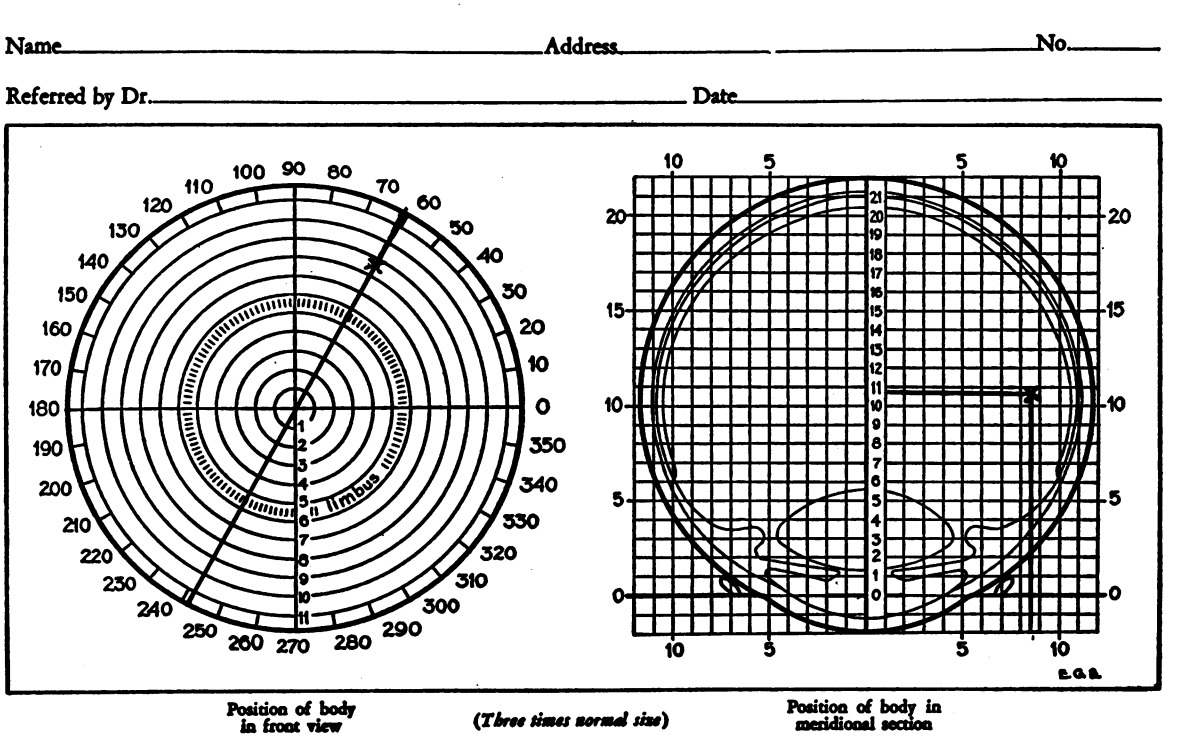

Figure 4.—Comberg's charts for plotting localization in the two views.

If severe intraocular infection develops, with loss of light projection, removal of the eye is advisable.

As magnetic foreign bodies usually can be removed without difficulty while nonmagnetic particles present an entirely different problem, it is important to know before operation whether the particle is magnetic or not. Theoretically a radio-amplification device, such as the Berman Locator[4] would be an ideal instrument to use in cases of doubt. If such an instrument is not available, other methods of differentiation must be used. As patients with shrapnel injuries of the eyes usually had similar particles imbedded about the face, these were removed and tested for magnetic reaction. In the absence of such particles we had to resort to the use of the magnet for differentiation.

Magnetic particles may be removed by the anterior or the posterior route, the choice depending on the size and shape of the foreign body and the damage suffered by the eye. The author believes that when the foreign body is small, when a cataract is already present or when the particle is located in the region of the macula, the anterior route should be used, and that large, jagged particles should be removed by the posterior route, especially if the lens is clear.

In extracting foreign bodies by the anterior route the giant magnet is used and exact localization is not necessary. The pupil is dilated widely and the magnet is applied first at about 12 inches from the cornea, using the least amount of current available. The current is turned on intermittently and is increased gradually. The magnet also is slowly brought closer to the cornea. If the foreign body is attracted by the magnet the iris is seen to bulge forward and the patient will usually experience some pain. By careful manipulation of the magnet the particle is brought into the anterior chamber and is then extracted with the hand magnet through a corneal incision. The corneal incision should be so made as to avoid the formation of a large shelf. This can be accomplished more easily by using a cataract knife rather than a keratome.

Sometimes magnetic particles can be extracted by the anterior route several years following the injury. (Case 1, Figure 1.)

Extraction by the posterior route requires an incision in the sclera usually as near the foreign body as possible unless there is a fresh scleral wound already present. The incision should be meridional and large enough to allow the largest diameter of the particle to pass freely. If the incision need be large, an intrascleral suture should be inserted before completion of the incision. To prevent retinal detachment, diathermy coagulation should be employed around the incision. When the particle is in the vitreous, an equatorial incision may be made over the flat portion of the ciliary body to avoid making a hole in the retina as advocated by Verhoeff[7] or a trephining hole as used by Barbour and Fralick.[1] The incision may be made also at the ora serrata along the anatomical attachment of the retina. The tip of the hand magnet is then introduced into the eye for a distance of about 2 mm., the current is turned on and the particle extracted. After extraction of any intraocular foreign body, atrophine is used, the eye is covered and the patient is kept quiet for several days. The following case illustrates this method of extraction:

CASE REPORT

The patient was hit in the left eye by shrapnel. On admission to the hospital a month later, vision in the left eye was 20/40. There were no external signs of injury but the vitreous presented a particle which appeared to be a foreign body. The lens was clear. X-ray examination showed an intraocular, metallic foreign body measuring approximately 2 mm. in diameter and located in the 62 degree meridian in the superior temporal quadrant, 8.6 mm. from the visual axis and 10.6 mm. posterior to the limbal plane (Figures 2, 3 and 4). The sclera was exposed in the indicated region, an equatorial incision 4 mm. long was made half way through the sclera 10 mm. from the limbus, a mattress suture was inserted and the incision was completed to the choroid. Diathermy coagulation was used around the incision and the choroid was incised with a sharp cataract knife. The tip of the hand magnet was inserted into the wound, the foreign body was extracted without difficulty and the incision was closed. Subsequent progress was uneventful and the vision remained 20/40.

Nonmagnetic particles when visible in the anterior chamber may be extracted with special forceps through a corneal incision. Similar particles in the posterior segment are difficult to remove and it is often less dangerous to leave them undisturbed than to attempt their removal. Small particles of glass and other inert substances are often well tolerated by the eye and may be retained for many years without much damage to vision. We have left undisturbed a majority of the eyes harboring tiny particles of nonmagnetic shrapnel which had not caused any reaction during the period of observation of six months or longer.

Particles of copper are notoriously poorly tolerated and whenever possible should be removed. Such particles when visible in the vitreous may be removed with special or improvised forceps, as illustrated by the following case:

CASE REPORT

The patient received an injury to the left eye when a copper blasting cap exploded in his hand. Vision in the injured eye was 20/70. The vitreous was somewhat hazy due to the presence of blood, but a tiny, glistening particle, presumed to be copper, could be seen floating in its anterior portion. The anterior chamber and intraocular pressure were normal. There was no visible evidence of a wound. Roentgenograms did not show evidence of an intraocular foreign body, but two particles were present in the soft tissues. Application of the giant magnet did not attract the intraocular particle. Two days after the injury the blood in the vitreous had absorbed sufficiently to allow good visualization of the foreign body.

The particle was removed with a Kalt capsule forceps after obliterating the curve of the forceps. The sclera of the superior temporal quadrant of the globe was exposed, a small equatorial incision was made halfway through the sclera in the region of the ora serrata, a suture was placed through both lips of the incision and the incision was completed into the vitreous. The forceps was introduced into the vitreous and under direct visualization the particle was

grasped and extracted. It proved to be a particle of copper measuring 1 mm. in diameter. The patient was given prophylactic injections of typhoid antigen intravenously and sulfadiazine orally. He was discharged from the hospital three weeks later with visual acuity of 20/20. Three months following the injury vision was 20/15 and the eye appeared normal.

Large particles of copper when embedded in the deep structure of the eye will certainly cause subsequent reaction and should be removed. The following case illustrates this point and shows how a large particle may be removed from the ciliary body:

CASE REPORT

The patient was struck in the right eye by a piece of wire. He was treated at the time and when the eye was free of inflammation was discharged to duty with vision of 20/20. According to the history an x-ray examination at that time revealed no foreign body. Approximately six months later, vision gradually became blurred and the patient was admitted to the hospital 15 months following the accident. Vision in the affected eye was limited to ability to distinguish hand movements. There were cells in the anterior chamber, and the lens was opaque and dislocated. Intraocular pressure was normal. X-ray examination disclosed a foreign body 11 mm. long located in the inferior temporal quadrant, in the ciliary body, somewhat concentric with the limbus (Figure 5). A meridional incision 5 mm. long was made over the foreign body which was engaged with a blunt iris hook and extracted.

Occasionally an intraocular foreign particle may spontaneously work out to the surface through the original wound or through the surgical incision following an unsuccessful attempt at removal, as illustrated by the following case:

CASE REPORT

The patient was hit in the eye by a particle of shrapnel. He entered the hospital eight weeks later, at which time vision in the injured eye was 20/70. X-ray examination disclosed a metallic particle in the inferior temporal quadrant, 6.8 mm. from the visual line, 3.2 mm. posterior to the limbus (Figure 6). Details of the fundus could not be made out due to the presence of blood in the vitreous. The indicated area was exposed, a 5x2 mm. scleral flap was raised and the hand magnet applied over this area, without success. The reaction in the eye subsequently quieted and vision improved to 20/40. Six months later, the particle was seen to bulge under the conjunctiva and it was removed with a forceps. It was nonmagnetic.

Undoubtedly many nonmagnetic particles may be successfully removed from the eye with the aid of the biplane fluoroscope or the ocular endoscope, but the author has used the former in one case without success and has had no experience with the ocular endoscope.

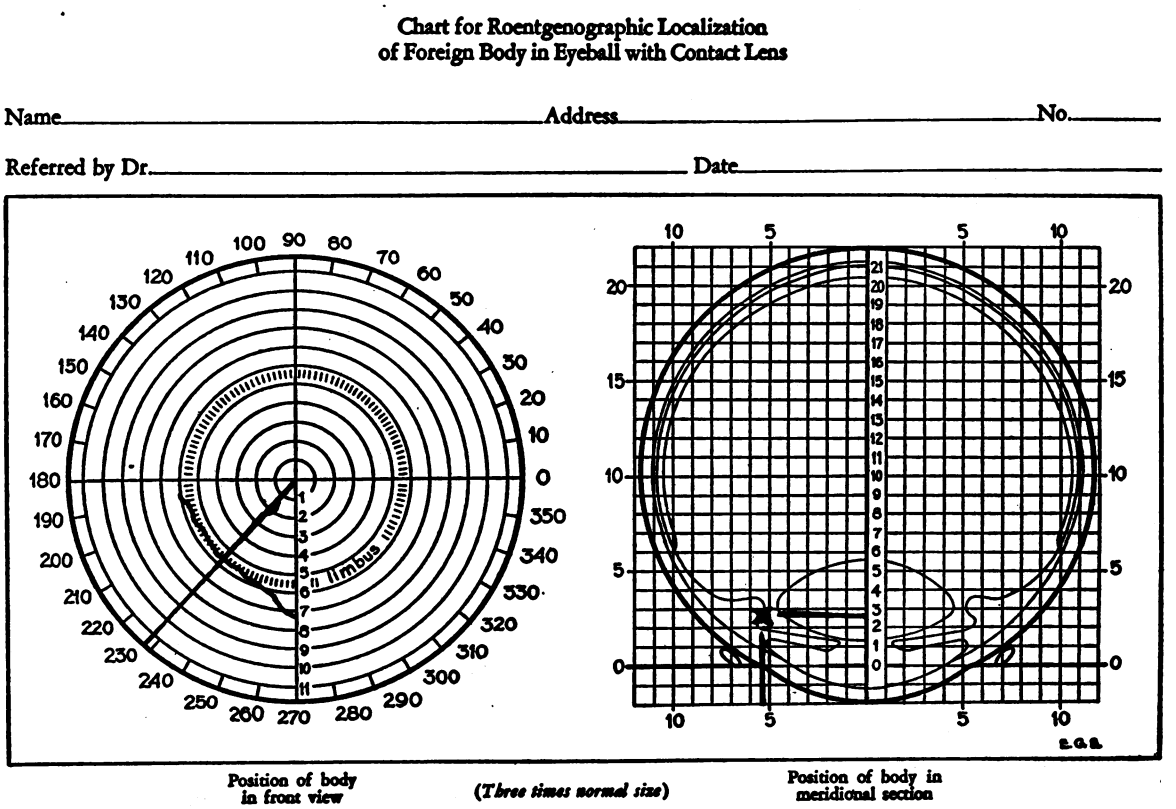

Figure 5.—A long piece of copper wire localized in the ciliary body.

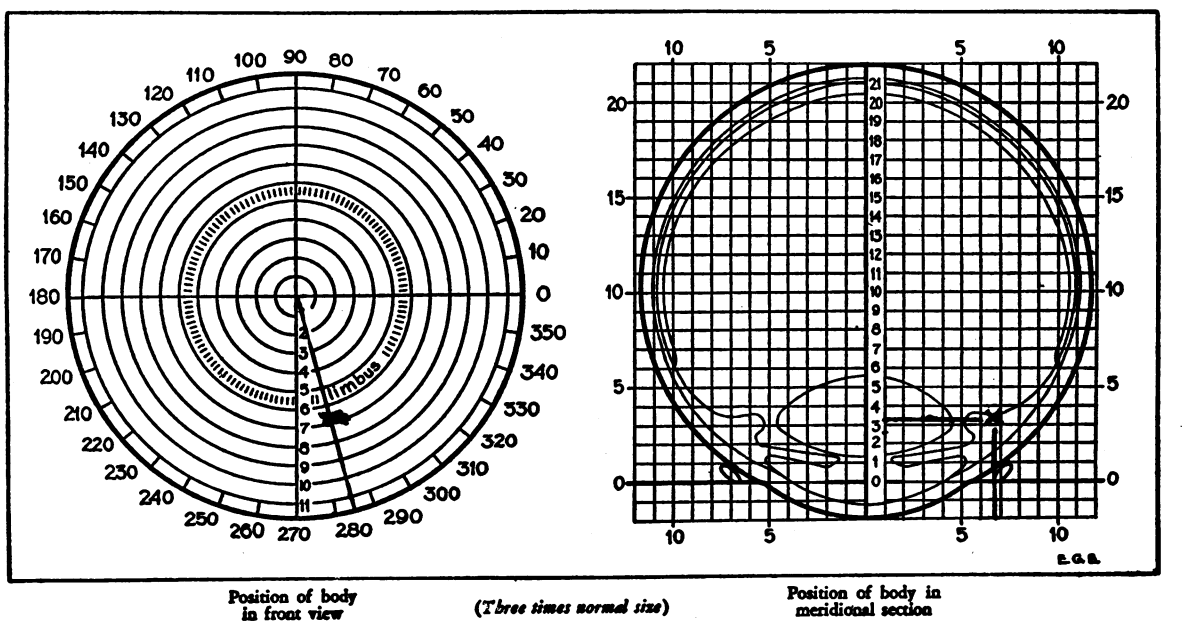

Figure 6.—Nonmagnetic foreign body localized in the ciliary body, worked out spontaneously.

Small foreign bodies located in the crystalline lens, if nonirritating, like a piece of glass or aluminum, should be left undisturbed as they may not cause progressive opacification. A patient was admitted to the hospital three days following multiple injuries received in combat. In the cortex of the left lens, just above the center, there was a glistening particle which was presumed to be aluminum. The path made by the particle could be traced through the eye by the scar in the cornea, the hole in the iris and the anterior capsule of the lens. Vision in this eye was 20/40. The particle was considered nonmagnetic and no attempt was made to remove it. Six months later vision in this eye was 20/20 and there was no sign of active inflammation in the eye.

Any penetrating injury of the eye is a potential cause of sympathetic ophthalmia. It is remarkable that not one case of this dread disease has occurred among perhaps 150 patients with penetrating injuries that were observed during the entire war at one of the largest naval hospitals.

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